INSTRUCTIONS GEK-5280D

LUBRICATING-OIL SYSTEM

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DESCRIPTION

The engine lubricating-oil system provides pressure lubrication to bearings within the engine and carries away heat produced by friction and combustion.

The lubricating-oil system consists of the following components in their order of oil flow (see Fig. 1): *

1. Engine crankcase
2. Pump
3. Relief valve
4. Filter
5. Cooler

For older locomotives; since early-1975 these components are in reverse order.

6. Regulating valve (where used)
7. Engine oil header and supply passages.

An oil pan is bolted to the main frame to enclose the bottom of the crankcase and hold the oil supply. The oil fill opening (see Fig. 2) is located on the free end of the engine under the left-bank intercooler. A dipstick is provided for measuring the crankcase oil level. The oil on the dipstick should read between FULL and LOW, with the engine idling.

OIL FLOW OUTSIDE THE ENGINE

Oil discharged from the pump is piped to the lube-oil filter. A relief valve protects the system against excessive pressure.

Oil is forced through the oil filter, which contains clamped-in filter elements.

Oil discharged from the filter is conducted to the oil inlet end of the oil cooler. The water flowing through the tubes inside the cooler removes heat from the oil.

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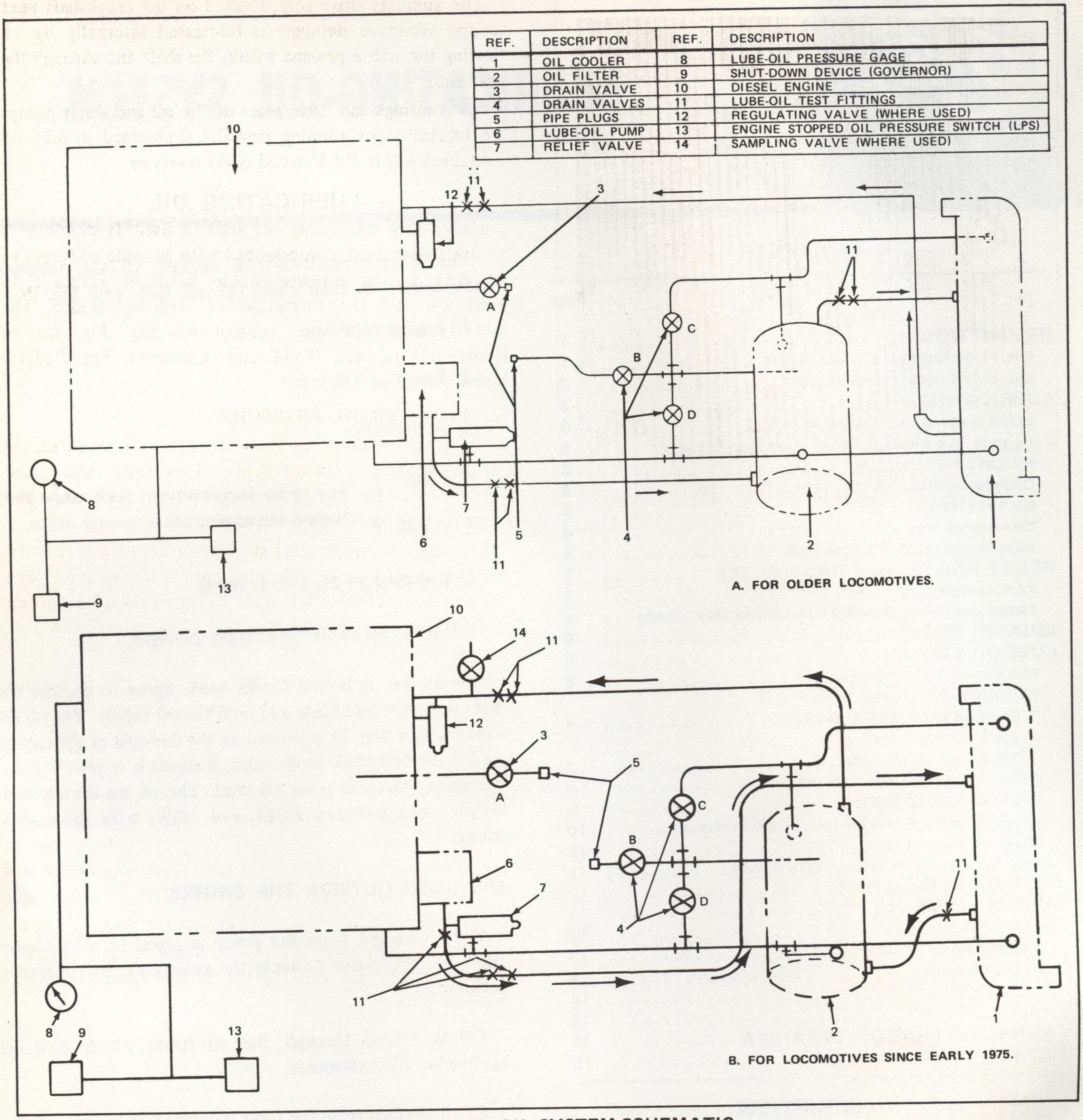
*Revisions are indicated by marginal bars.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

GENERAL ELECTRIC



REF.	DESCRIPTION	REF.	DESCRIPTION
1	OIL COOLER	8	LUBE-OIL PRESSURE GAGE
2	OIL FILTER	9	SHUT-DOWN DEVICE (GOVERNOR)
3	DRAIN VALVE	10	DIESEL ENGINE
4	DRAIN VALVES	11	LUBE-OIL TEST FITTINGS
5	PIPE PLUGS	12	REGULATING VALVE (WHERE USED)
6	LUBE-OIL PUMP	13	ENGINE STOPPED OIL PRESSURE SWITCH (LPS)
7	RELIEF VALVE	14	SAMPLING VALVE (WHERE USED)

A. FOR OLDER LOCOMOTIVES.

B. FOR LOCOMOTIVES SINCE EARLY 1975.

FIG. 1. LUBE-OIL SYSTEM SCHEMATIC.

FIG. 1, E-14809B

Oil discharged from the cooler is piped to the engine free-end cover.

OIL FLOW INSIDE THE ENGINE

The main engine supply header and branch passage within the main frame conduct oil to all main bearings and to four camshaft bearings (front and rear, left and right bank). Oil enters the crankshaft from the main bearings and flows through angularly-drilled passages in the shaft to the connecting-rod main bearings.

The oil passes upward from the connecting-rod bearings, through drilled passages in the rods, to lubricate the articulated-rod bearings and piston pins and to cool the pistons. It then flows through openings inside the pistons to return to the crankcase.

The oil entering the camshaft bearings is conducted lengthwise through the drilled camshafts. Holes drilled radially into the shafts supply oil to each of the other shaft bearings.

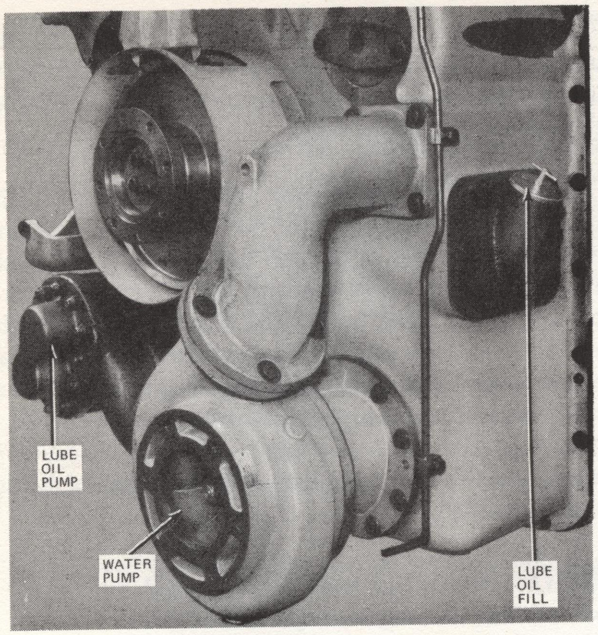


FIG. 2. ENGINE DETAILS.

FIG. 2, E-14810

The camshaft bearings contain annular grooves connecting to drilled passages in the engine main frame. Oil flows through these passages to the valve and fuel push-rod crossheads.

The oil also flows upward through the valve push rods to supply lubrication to the working valve parts at the top of the cylinder. Oil return is through the valve push-rod cavities, to lubricate the cams and cam rollers, and then to the crankcase.

The free-end cover bearing and the idler-gear bushings are lubricated through a passage from the oil header to an annular groove around the cover bearing. Another drilled passage connects the annular bearing groove to a drilled passage in the idler-gear shaft. Oil from these bearings returns by gravity to the crankcase.

The turbocharger bearings receive lubrication through an external line, flange-connected to the oil header at the free-end cover. From the turbocharger, the oil is returned to the crankcase through a pipe that is also flange-connected to the cover.

Lubricating oil is piped to the governor-drive assembly and to the low-oil-pressure shut-down device located on the engine control governor. This pipe is flange-connected to the engine oil header at the generator end. The oil from the governor drive returns to the crankcase internally.

The oil supply for the overspeed governor is maintained in a small reservoir built into the governor-drive gear case. The reservoir is kept filled with oil by a drilled passage in the gear case.

The camshaft gears are splash-lubricated through an orifice and pipe from the engine oil header.

The auxiliary drive gear, located on the crankshaft next to the vibration damper, is lubricated internally by oil flowing through a passage within the shaft and through the gear hub.

The bearings and drive gears of the oil and water pumps are lubricated by running partially submerged in lube oil contained within the free-end cover reservoir.

LUBRICATING OIL

Heavy-duty lubricating oil must be used. It should be a neutral mineral oil, compounded with suitable additives to provide a non-corrosive stable lubricant resistant to oxidation and the formation of acid and sludge. The additives should also control foaming. For further information, see Fuel and Lubricant Specification instruction, Tab RM-3 or 4.

LUBRICATING-OIL PRESSURE

Oil pressure must be maintained at all times during engine operation. Insufficient oil pressure will cause extensive damage to the bearings, pistons, cylinders, and other moving parts within the engine.

The low-lube-oil pressure shut-down device will stop the engine and turn on an indicating light in the operator's cab if a condition of insufficient oil pressure exists. For further information, see Engine Control Governor instruction, Tab DE-8.

When the engine is operating within its normal temperature range, the oil header pressure should be between 20 and 100 psi (1,41 and 7,03 kg/cm^2 or 138 and 689 kPa).

During engine starting, a time delay built into the low-oil-pressure shut-down device allows time for the engine oil pressure to build up. If the pressure fails to build up within the time allowed, the low-oil-pressure device will trip and prevent the engine from starting.

A pressure switch also monitors the lube-oil header pressure and, whenever a set low pressure value is reached, causes control circuits to shut off the fuel pump motor and shut down the engine.

FILLING, DRAINING, AND CHANGING OIL

FILLING THE SYSTEM

To service the lubricating-oil system, proceed as follows:

1. Ascertain that the four drain valves are closed (Fig. 1). Also, be certain the plugs are in valve A and the overboard drain from valve B (Fig. 3).
2. Fill the crankcase, either through the oil fill opening or a crankcase inspection opening, with the correct quantity of new lubricating oil. The oil must conform to the required specifications. See Fuel and Lubricant Specification instruction, Tab RM-3 or 4. Fill the crankcase to the FULL level mark on the dipstick.

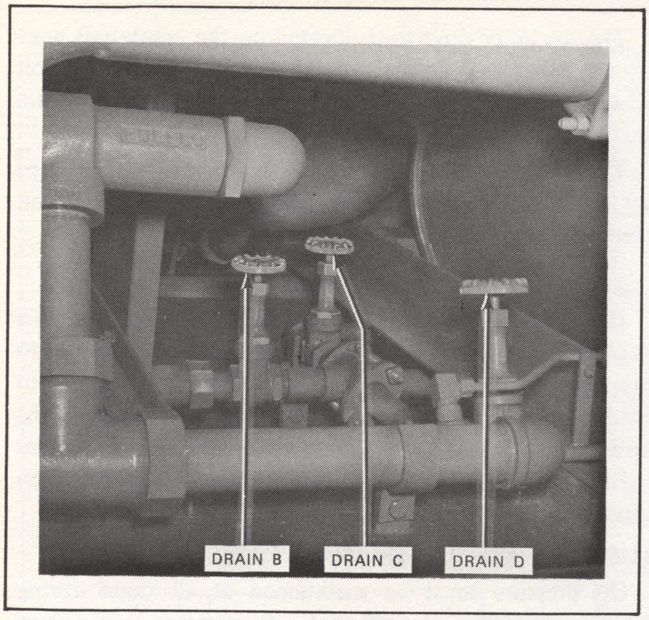


FIG. 3. LUBE-OIL DRAIN VALVES — "B", "C" AND "D" (TYPICAL ARRANGEMENT).

Additional oil will have to be added after the engine has idled and oil has dispersed through the system.

3. With the engine idling, the oil level must be between the FULL and LOW marks on the dipstick.

DRAINING THE SYSTEM

There are several methods which can be employed to drain the lube-oil system – varying with the combination of valves used and the desired effect. Four valves, A, B, C and D (see Figs. 1 and 3), are used in draining the lube-oil system. Valve A is the crankcase-drain valve, and is located under the platform in front of the No. 2 truck. Valves B, C and D are located above the deck, between the lube-oil filter and the free-end cover of the engine. The draining combinations are as follows:

1. Removing the plug and opening valve A drains the crankcase.
2. To drain the entire system, remove the plug from valve A, the plug from the overboard drain from valve B, and open valves A, B, C and D.
3. Removing the plug from the overboard drain and opening valve B drains the oil overboard from the unfiltered side of the oil filter.
4. Opening valve D drains the unfiltered side of the filter back to crankcase level.
5. Removing the plug from the overboard drain, then opening valves B and D, drains the oil overboard from the unfiltered side of the filter and front-end cover of the engine.
6. Removing the overboard drain plug and opening valves B and C drains all oil from the filter and lube-oil cooler overboard.

DRAIN PIPES

There are two lube-oil drain pipes. One is for the rack (valve B), and the other is for the crankcase (valve A). In addition, there is a sump drain pipe which carries away all liquids that collect in the sump.

All three drain pipes pass downward through the locomotive platform, then to the side of the platform between the rear end of the fuel tank and the No. 2 truck. Valve A is located below the deck and is equipped with a pipe plug at its outlet port. Valve B is located above the deck, and the drain pipe terminates below the deck at an elbow equipped with a pipe plug. The sump drain is open at both ends and must be kept free at all times.

Plugs used in the drain lines must be removed before opening valves A or B.

NOTE: *Both plugs must be reinstalled and valves closed when draining is completed.*

CHANGING OIL

1. Arrange barrels or a drain hose system to catch the used oil as it escapes from the drain pipes.
2. Open the appropriate drain valve as indicated in Draining the System section.
3. After all old oil has drained from the system, renew the lube oil filter elements. See Renewing Filter Elements section.
4. Check the engine crankcase for all foreign objects. On newer locomotives equipped with the crankcase lube oil strainer, remove and clean the strainer basket. See Crankcase Lube-Oil Strainer section.
5. Close all drain valves and fill the system with new lube oil. See Filling the System section.

RENEWING FILTER ELEMENTS

To renew the filter elements (as between oil changes), refer to Fig. 1 and 5 and proceed in the following manner:

1. Open valve D, which will drain part of the oil from the unfiltered side of the filter back to the crankcase.
2. Remove the vent pipe plug from the filter cover. Filter drain-back may be expedited by applying air pressure (not over 50 psi/3,52 kg/cm^2 or 345 kPa) at the filter vent. Observe applicable safety precautions.

3. Loosen the hinge-bolt nuts, and open the hinged cover after the oil has drained back to the crankcase.

4. Close valve D.

5. Remove the plug from the overboard drain, and place a container under the drain. Open valve B. This will drain off the balance of the oil from the unfiltered side of the filter and also will carry off most of the dirt accumulated by the filter. About 15 U.S. gal. (57 liters) will be drained by this method.

NOTE: *Some customers may prefer to drain overboard all of the dirty oil from the filter housing. This may be accomplished by performing Step 5 and removing the vent pipe plug from the filter cover.*

6. Remove the wing nuts and the element hold-down plates.

7. Remove the dirty elements, and place them in a container to catch the drippings. Inspect the outer surface of each element for metal particles.

8. Wipe out the inside of the filter housing and remove all sludge deposits.

CAUTION: *In operation, filtered oil is conducted by the filter support tubes to the clean side of the filter housing. During cleaning, do not permit ANY particles of sludge or dirt to pass thru these tubes, or damage to critical engine components can occur.*

9. Install new elements and secure with element hold-down plates and wing nuts. Tighten nuts evenly. HAND-TIGHTEN ONLY. Be sure filter elements are all seated and clamped securely.

NOTE: *Depending on locomotive application, the quantity of filter elements may vary up to eight elements. Install new elements in the same positions occupied by the elements removed in Step 7. Use GE Renewal Part elements which are marked "LUBE OIL ONLY" on the top cover.*

10. Inspect the filter cover gasket and replace it, if damaged. Close the cover and secure with hinge bolts and nuts.

11. Replace the vent pipe plug.

12. Close the B valve and install the plug in the overboard drain.

13. After engine is started and running at idle speed, top off the crankcase to the FULL mark on the dipstick.

RELIEF AND REGULATING VALVES

The pressure and flow within the lube-oil system are automatically controlled by two pressure-operated valves:

1. Pump relief valve

2. Engine pressure-regulating valve (where used).

These valves are held closed by adjustable spring pressure. When sufficient oil pressure is developed, it will overcome the spring pressure, causing the valve to open and pass oil.

The function of each of the two valves within the system should be understood thoroughly before any attempt is made to change their settings. Normally these valves do not get out of adjustment. However, they may fail to function properly due to leakage caused by a damaged seat, by dirt which holds the valve off its seat, or by dirt wedged around the valve stem, which causes erratic valve operation. When disassembling a valve for cleaning, always mark the adjustment so that it may be returned to its correct setting without removal from the system.

PRESSURE-RELIEF VALVE

The pressure-relief valve, located near the outlet of the lube-oil pump, protects the system against excessive oil pressure which may develop should the system become restricted or the filters dirty. If the pump discharge pressure exceeds the valve operating pressure, the valve will be forced open, permitting oil to flow to the free-end cover, thus limiting the pressure. The oil-pump relief valve can be set best by removing it from the locomotive and setting on a test stand similar to the one illustrated in Fig. 4. Instructions for setting the valve are as follows:

1. Start the pump with A open.

2. Close A until the set pressure is reached.

3. Adjust the valve until the oil starts to flow. If the pump flow is 20 gpm (76 liters) or less, the valve can be set with A closed completely.

If necessary to set the valve on the locomotive, it can be done with clean filters and cold oil (100 F/38 C or less). Start the engine. At idle, set the valve at the proper pressure. See DATA section.

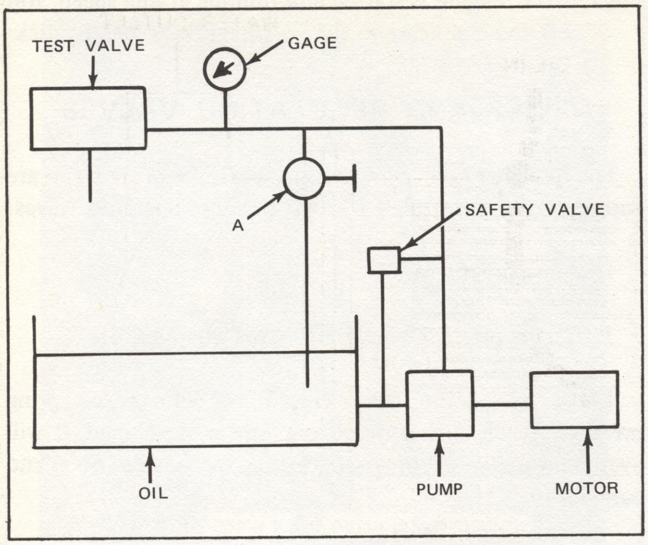


FIG. 4. TEST ARRANGEMENT FOR ADJUSTING VALVES.

FIG. 4, E-13210A

PRESSURE-REGULATING VALVE (WHERE USED)

The pressure-regulating valve, located in the inlet pipe at the free-end cover, maintains a relatively constant engine oil header pressure over the full engine speed range.

The valve is similar to the pump relief valve and is set in the same manner except that, if set in the locomotive, the engine should be running at maximum speed and the oil should be hot (165 to 180 F/74 to 82 C). Pressure should be 65 to 75 psi (4,57 to 5,27 kg/cm^2 or 448 to 517 kPa) at full speed; at idle speed, pressure will be approximately 20 psi (1,41 kg/cm^2 or 138 kPa).

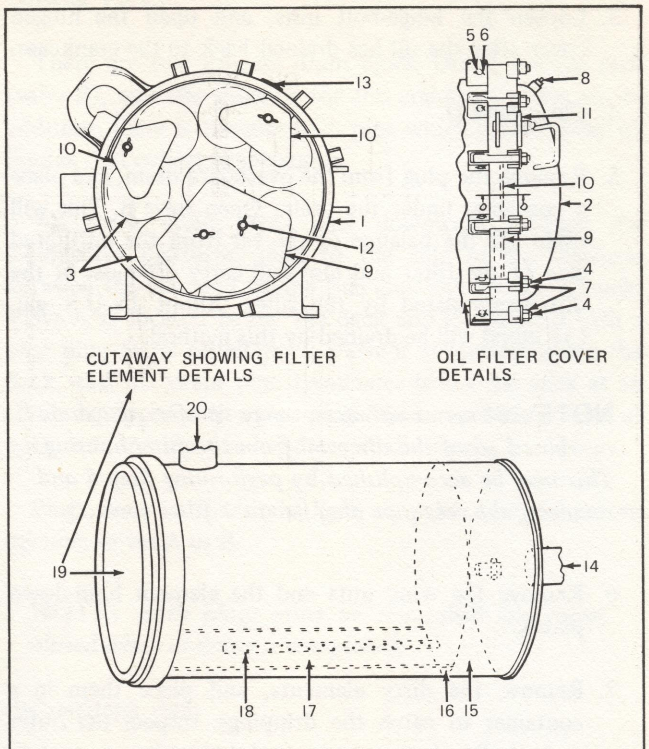
LUBE-OIL FILTER

The lube-oil filter housing (Fig. 5) is a fabricated, cylindrical, steel shell. It has a hinged and gasketed cover which is clamped to hold maximum system pressure.

Internally, the filter is arranged with two separate cavities. Oil flowing into the filter shell passes inward through the elements, located in the upper cavity, downward through the element centers into the lower cavity, and out through the outlet pipe.

LUBE-OIL COOLER

The lube-oil cooler (Fig. 6) is located on the locomotive deck and is usually under the engine air filter between the lube-oil filter and the radiator compartment. In some applications it is located in the radiator compartment behind the radiator fan drive assembly.



CUTAWAY SHOWING FILTER ELEMENT DETAILS

OIL FILTER COVER DETAILS

REF.	DESCRIPTION	REF.	DESCRIPTION
1	OIL-FILTER HOUSING	11	GUIDE
2	OIL-FILTER COVER	12	WING NUTS
3	FILTER ELEMENTS	13	NAMEPLATE
4	HINGE BOLT	14	OUTLET TO COOLER
5	PIN	15	FILTERED OIL
6	COTTER PIN	16	PLATE
7	HEX NUT	17	UNFILTERED OIL
8	FILTER VENT PLUG	18	FILTER SUPPORT TUBE
9	ELEMENT HOLD-DOWN PLATE	19	OIL-FILTER SECTION
10	ELEMENT HOLD-DOWN PLATES	20	INLET FROM OIL PUMP

FIG. 5. LUBE-OIL FILTER.

FIG. 5, E-14811B

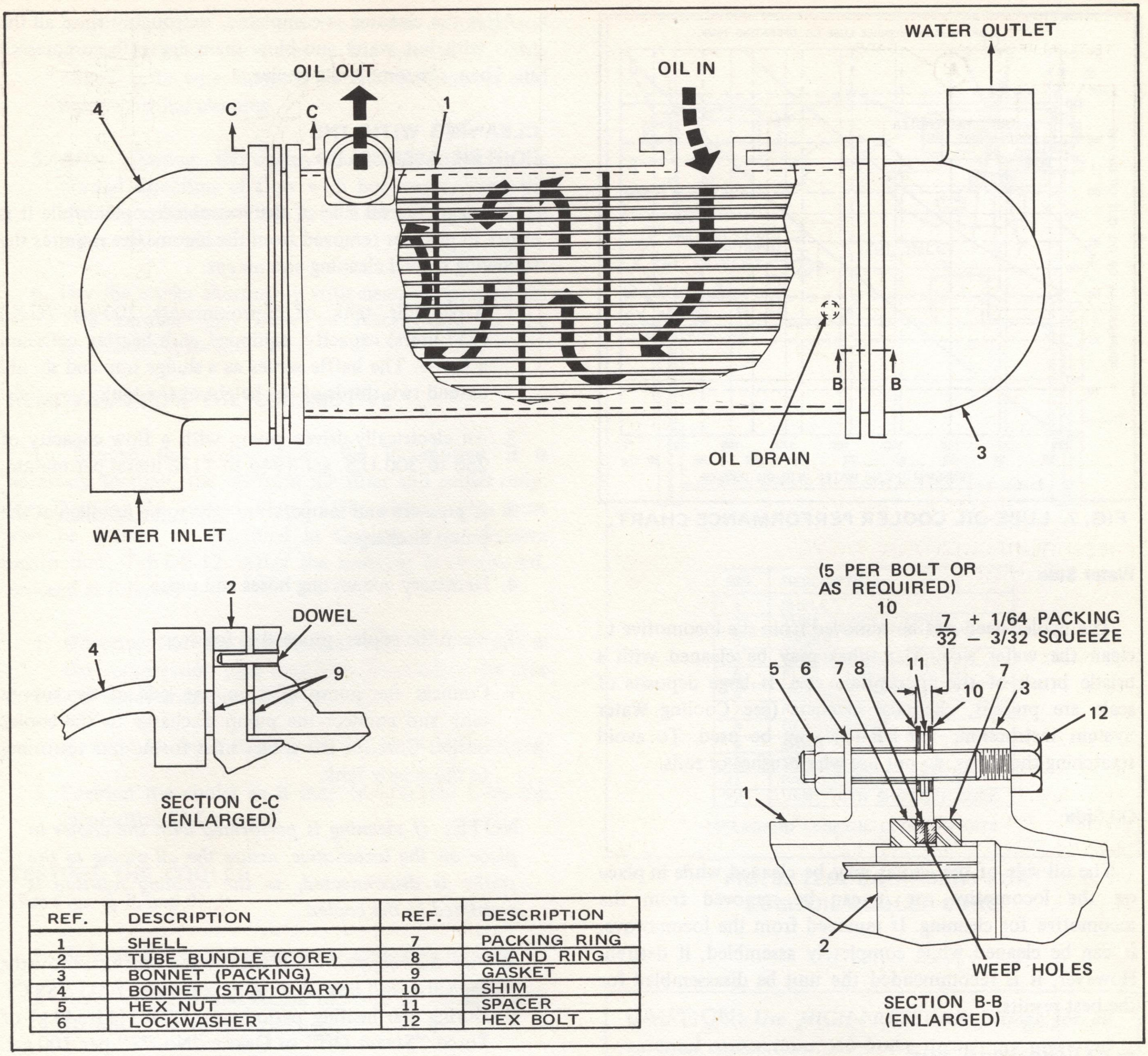
The lube-oil cooler is of the "single pass" type, in that the cooling water passes through the cooler in one direction only. The flow of oil is controlled by a series of baffles which cause the oil to flow in a zigzag path around the tubes in the water tube bundle. This tends to promote the cooling effect by ensuring maximum oil-water tube exposure.

Water flows into the oil cooler at the opening in the water inlet bonnet. Upon reaching the tube sheet, the water is dispersed, through the individual tubes of the tube bundle, through the oil chamber. The water then reaches the outlet bonnet, where it is discharged from the oil cooler.

CLEANING THE COOLER

Determining Cooler Condition

To determine if the lube-oil cooler requires cleaning, the maximum stable temperature of the lube oil leaving the engine and the cooling water entering the lube-oil cooler


WATER OUTLET
OIL OUT
OIL IN
C
C
4
1
B
B
OIL DRAIN
3
WATER INLET
2
DOWEL
4
9
SECTION C-C
(ENLARGED)
(5 PER BOLT OR
AS REQUIRED)
10
7/32 + 1/64 PACKING
– 3/32 SQUEEZE
5
6
7
8
11
7
10
3
12
1
2
WEEP HOLES
SECTION B-B
(ENLARGED)

REF.	DESCRIPTION	REF.	DESCRIPTION
1	SHELL	7	PACKING RING
2	TUBE BUNDLE (CORE)	8	GLAND RING
3	BONNET (PACKING)	9	GASKET
4	BONNET (STATIONARY)	10	SHIM
5	HEX NUT	11	SPACER
6	LOCKWASHER	12	HEX BOLT

FIG. 6, E-17743

FIG. 6. LUBE-OIL COOLER.

must be accurately measured and plotted against the curve shown in Fig. 7. To obtain the maximum stable temperatures in the systems during the cooler test, the engine must be operated for a sufficient length of time at its full horsepower rating. At no time during the test should the temperature of the lube oil leaving the engine be permitted to exceed 220 F (104 C).

To perform the test, install two accurate 250 F (121 C) temperature gages, one at each of the following points.

1. Lube-oil pump discharge pipe
2. The water line from the radiator to the lube-oil cooler.

Preparation for Cleaning

Before cleaning either the water side or the oil side of the cooler:

1. Drain all oil from the cooler. See Step 6 of Draining the System section (of this instruction).
2. Drain the cooling-water system. See "Draining the System", in the Pressurized Cooling Water instructions, Tab DE-12.

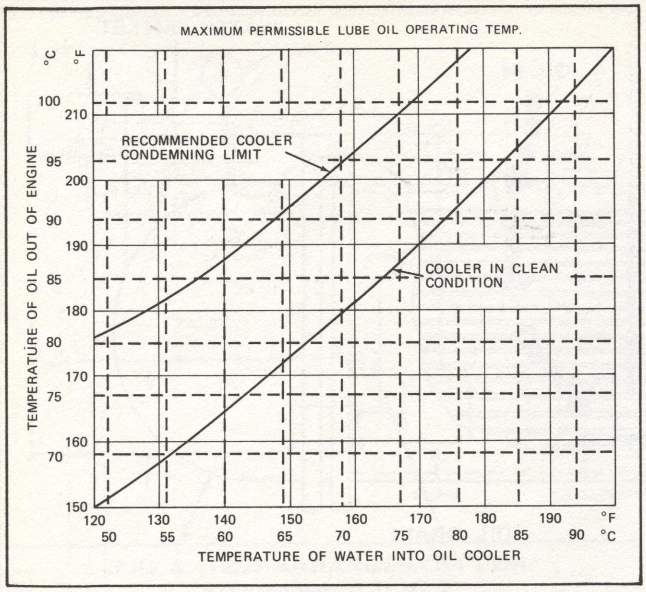


FIG. 7. LUBE-OIL COOLER PERFORMANCE CHART.

FIG. 7, E-13197A

Water Side

The cooler need not be removed from the locomotive to clean the water side. The tubes may be cleaned with a bristle brush of the appropriate size. If large deposits of scale are present, chemical cleaners (see Cooling Water System instruction, Tab DE-12) may be used. To avoid scratching the tubes, do not use wire brushes or rods.

Oil Side

The oil side of the cooler may be cleaned while in place on the locomotive, or it can be removed from the locomotive for cleaning. If removed from the locomotove, it can be cleaned while completely assembled, if desired. However, it is recommended the unit be disassembled for the best results.

CLEANING WITH THE COOLER DISASSEMBLED

Disassemble the cooler and submerge its parts in an agitated cleaning solution. The solution should consist of 25 lb. (11,34 kg) of Turco "Steam Off"* or Oakite "No. 77"** per 100 gal. (U.S.) (378 liters) of water, and should be maintained at approximately 190 F (88 C) during cleaning.

Check the tube bundle for cleanliness by inserting a brass strip between the tubes. If, when removed, the strip is coated with sludge, the tube bundle should receive further cleaning.

After the cleaning is completed, thoroughly rinse all the parts with hot water and blow them dry with compressed air. Then, reassemble the cooler.

CLEANING WITH THE COOLER ASSEMBLED

To clean the oil side of the assembled cooler while it is either in place or removed from the locomotive requires the following special cleaning equipment:

1. A suitable tank of approximately 200-gal. (U.S.) (757 liters) capacity, equipped with heating coils and a baffle. The baffle serves as a sludge trap and should extend two-thirds of the height of the tank.
2. An electrically-driven pump with a flow capacity of 250 to 300 U.S. gal. (946 to 1136 liters) per minute.
3. A pressure and temperature gage to be installed at the pump discharge.
4. Necessary connecting hoses and pipes.

To clean the cooler, proceed as follows:

1. Connect the pump inlet to one side of the supply tank and connect the pump discharge to the cooler outlet. Connect the cooler inlet to the line returning to the supply tank.

NOTE: *If cleaning is performed with the cooler in place on the locomotive, assure the oil piping to the cooler is disconnected, so the cleaning solution is restricted to the cooler.*

2. Fill the supply tank with water to three-fourths capacity, and heat it to approximately 190 F (88 C). During the heating period, add 25 lb. (11,34 kg) of Turco "Steam Off" or Oakite "No. 77" per 100 gal. (U.S.) (378 liters) of water.
3. Start the pump and circulate the solution through the cooler for three hours. Reverse the flow and circulate the solution for two additional hours. During this period, the temperature of the solution should be maintained near its boiling point. The rate of flow should be 250 to 300 gpm (946 to 1136 liters), with the pressure not to exceed 100 psi (7,031 kg/cm^2 or 689 kPa) at the pump discharge. If, during cleaning, the solution becomes excessively dirty, it should be renewed.
4. Stop the pump and allow the solution to drain from the cooler. Disconnect the lines from the cooler and check the cleanliness of the tube bundle by inserting a

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*Product of Turco Products, Inc.

**Product of Oakite Products, Inc.

length of piano wire into the cooler openings and spaces between the tubes in the bundle. If, upon removing the wire, sludge is present, the cooler should receive further cleaning.

5. After cleaning, thoroughly flush the cooler in its normal direction of flow with hot water, using the cleaning apparatus. Flush for 30 minutes, or until the water returns clean.

6. Dry the cooler thoroughly with clean compressed air. The cooler may now be reconnected to the locomotive system.

REMOVAL FROM THE LOCOMOTIVE

To remove the cooler from the locomotive, it is necessary to drain the oil from the filter and cooler only. (See Draining the System, Step 6.) The water system must also be drained as described in Cooling Water System instruction, Tab DE-12. After the draining is completed, proceed as follows:

1. Disconnect all the pipe connections to the cooler at the compression pipe couplings. Disconnect the lube and water drain pipes and vent line.

2. Remove the bolts holding the cooler to its mounting.

3. Position the cooler so it may be removed from the locomotive with a crane.

TESTING THE COOLER
(See Figs. 6, 8, and 9)

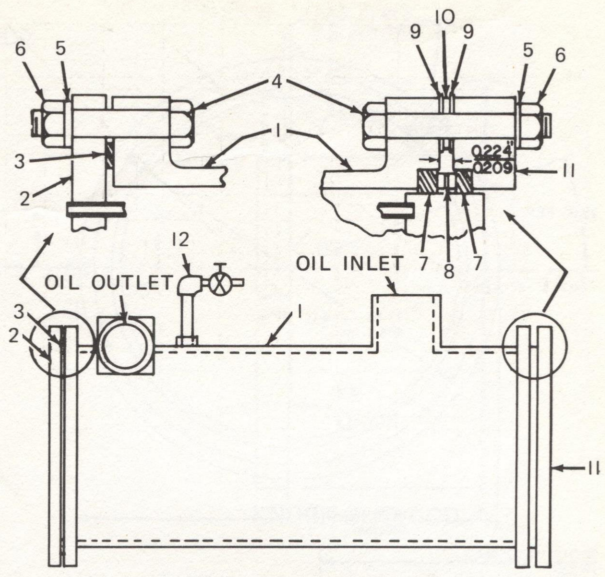
1. Refer to Fig. 6, and remove the stationary bonnet.

2. Refer to Fig. 8, and secure the core to the shell with 16 bolts, flat washers and nuts.

3. Refer to Fig. 6, and remove the other bonnet. Replace the bonnet with the packing-ring retainer and secure with 16 bolts, flat washers and nuts. Tighten to achieve a packing squeeze of 0.224 to 0.209 in. (5,7 to 5,3 mm). Refer to Figs. 8 and 9.

NOTE: *Make the packing-ring retainer locally. Details are shown on Fig. 9.*

4. Set up the cooler in the manner shown on Fig. 8. The cooler must be horizontal and oriented so the vent with shut-off cock is located at the top of the cooler shell. Secure the assembly, and connect the shell (oil) side of the cooler to a source of soluble oil in water which can be raised to a pressure of 225 psig (15,82 kg/cm^2 or 1551 kPa).



REF.	DESCRIPTION
1	SHELL*
2	TUBE BUNDLE (CORE)*
3	GASKET*
4	HEX-HEAD BOLTS (5/8-11)
5	FLAT WASHERS (5/8 IN.)
6	HEX-HEAD NUTS (5/8-11)
7	PACKING RINGS*
8	GLAND RING*
9	SHIMS*
10	SPACERS*
11	PACKING-RING RETAINER
12	VENT WITH SHUT-OFF COCK

*STANDARD LUBE-OIL COOLER PARTS

FIG. 8. TEST EQUIPMENT FOR LUBE-OIL COOLER CORE.

CAUTION: *Use HIGH-PRESSURE fittings for all external connections. Air-brake fittings are suggested for this application.*

5. Slowly pressurize the shell (oil) side of the core, venting the displaced air until the oil-water solution emerges from the vent.

6. Close the air vent and slowly increase the pressure up to 225 psig (15,82 kg/cm^2 or 1551 kPa). Inspect both ends of the cooler and look for defective tubes, which will be indicated by water leakage at the tube ends. The tube bundle (core) must be able to withstand the 225-psig (15,82 kg/cm^2 or 1551 kPa) pressure for a five-minute period.

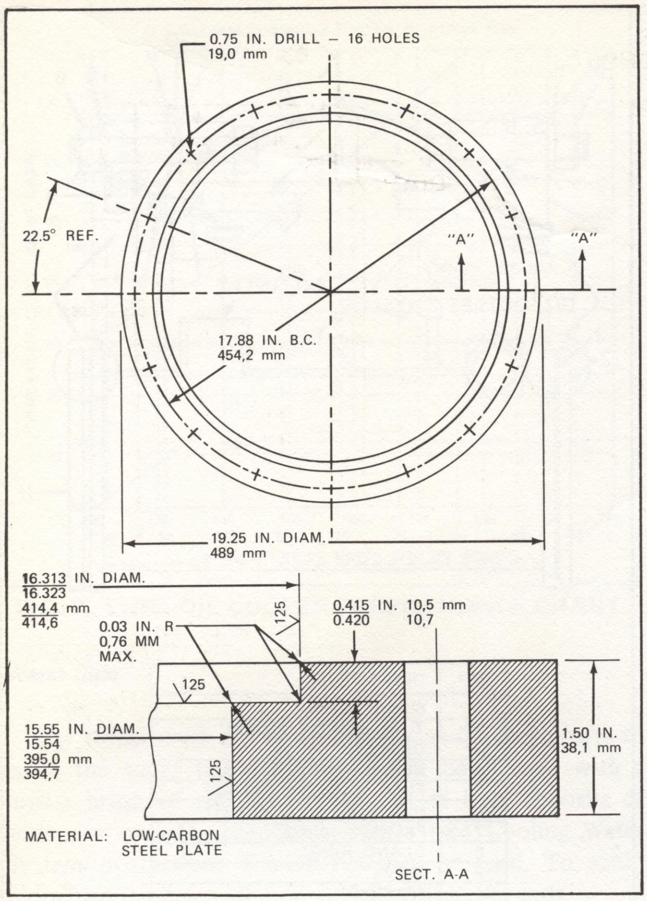

0.75 IN. DRILL – 16 HOLES
19,0 mm
22.5° REF.
"A"
"A"
17.88 IN. B.C.
454,2 mm
19.25 IN. DIAM.
489 mm
16.313 IN. DIAM.
16.323
414,4 mm
414,6
0.03 IN. R
0,76 MM
MAX.
125
0.415 IN. 10,5 mm
0.420 10,7
125
15.55 IN. DIAM.
15.54
395,0 mm
394,7
125
1.50 IN.
38,1 mm
MATERIAL: LOW-CARBON STEEL PLATE
SECT. A-A

FIG. 9. PACKING-RING RETAINER.

FIG. 9, E-17745A

CORRECTING LEAKS IN THE TUBE BUNDLE

NOTE: *Two sizes of quarter-hard 1/4-in. (6,35 mm) O.D. copper tubing have been used in LARGE oil coolers. If the tubing I.D. is 0.225 in./0.215 in. (5,7/5,5 mm), the tubing is 0.016-in. (0,40 mm) wall thickness; if the tubing I.D. is 0.212 in./0.200 in. (5,4/5,1 mm), the tubing is 0.022-in. (0,56 mm) wall thickness. Either size of tubing can be used for repairing a core, but the size must be known so proper tool selection can be made.*

Small oil coolers use both 1/4 in. (6,35 mm) O.D. tubes and 5/8 in. (15,88 mm) O.D. tubes in their core assemblies. The 5/8 in. (15,88 mm) tubes should have 0.049 in. (1,24 mm) wall thickness, while either type of 1/4 in. (6,35 mm) tube may be used for repairing this type of core. See Fig. 13.

Three methods of correcting leakage are:

1. If slight leakage exists at the fit of the tube in either end plate, use a tube roller and expand the tube slightly to seal the leak. See Figs. 11 and 12. This operation should be performed while the cooler is exposed to the 225-psig (15,82 kg/cm^2 or 1551 kPa) test pressure. The tube roller can be hand-driven with a tap wrench or power-driven as shown in the illustration. DO NOT ROLL IN EXCESS OF 2000 RPM.

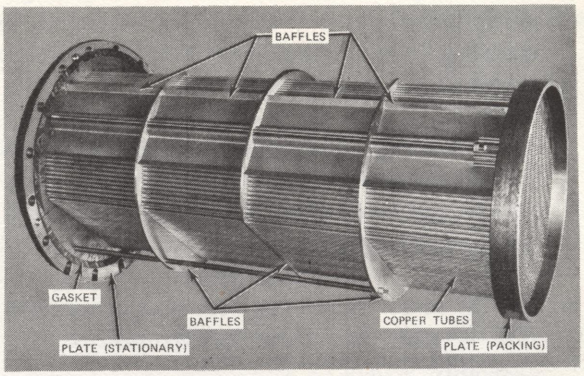

BAFFLES
GASKET
BAFFLES
COPPER TUBES
PLATE (STATIONARY)
PLATE (PACKING)

FIG. 10. LARGE TUBE BUNDLE (CORE) ASSEMBLY.

FIG. 10, E-17748

2. Replace a defective tube in the following manner:
    a. Ream both ends of the tube within 1/16 in. (1,6 mm) of the inboard end of the end plates. Use the pilot drill shown in Fig. 12.
    b. Place the guide rod, shown in Fig. 12, in the tube to be removed. This rod helps prevent tube buckling during removal.

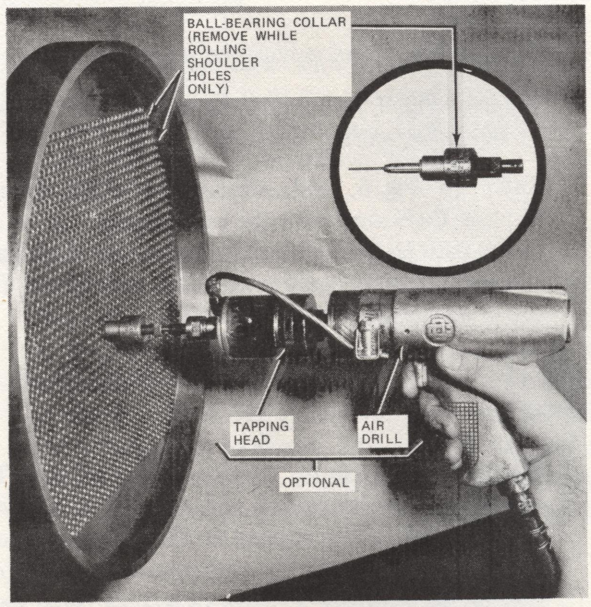
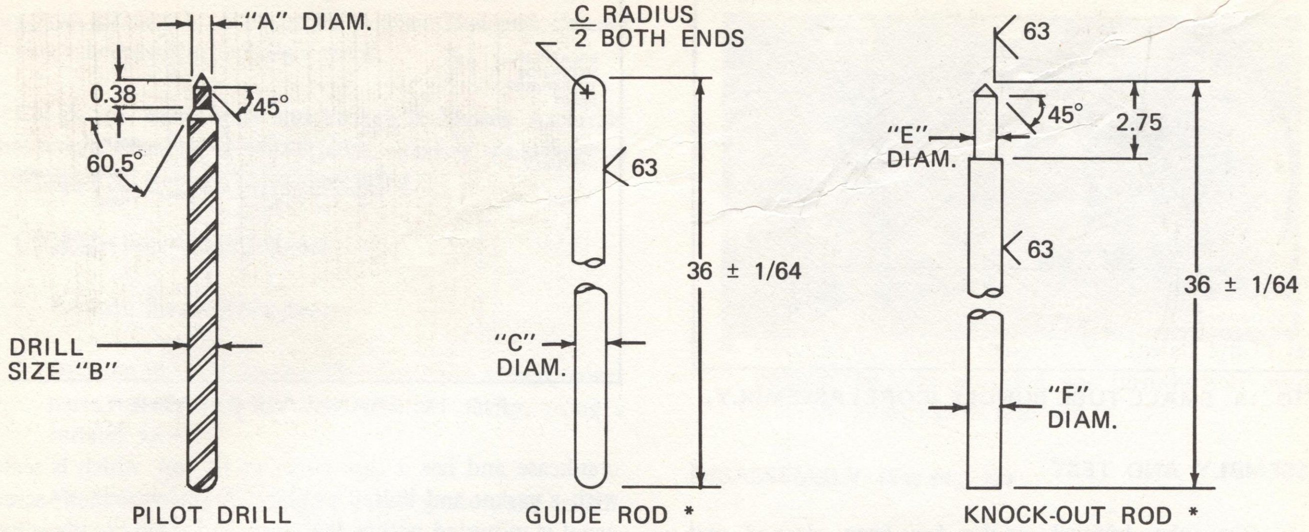

BALL-BEARING COLLAR (REMOVE WHILE ROLLING SHOULDER HOLES ONLY)
TAPPING HEAD
AIR DRILL
OPTIONAL

FIG. 11. ROLLING TUBE END OF LUBE-OIL COOLER.

FIG. 11, E-17746



TUBE O.D.	TUBE WALL THICKNESS	A	B	C	E	F	MATL*	ROLL TOOL	
								MODEL NO.**	GE PART NO.
0.250	0.016	0.223/0.221	1/4	0.212/0.210	0.215/0.213	0.252/0.250	DRILL ROD	41AA2526**	147X1782
0.250	0.022	0.211/0.209	D(0.246)	0.197/0.195	0.199/0.197	0.252/0.250	DRILL ROD	41AA2524**	147X1781
0.625	0.049	0.560/0.558	5/8	0.551/0.549	0.554/0.552	0.627/0.625	DRILL ROD	B3300***	2X3158

ALL DIMENSIONS ARE IN INCHES

MAKE DRILL AND RODS LOCALLY

**ROLL TOOL MFD. BY
THOMAS C. WILSON, INC.
LONG ISLAND CITY, N.Y. 11101

***ROLL TOOL MFD. BY
ELLIOTT CO., DIV. OF CARRIER CORP.
SPRINGFIELD, OHIO

FIG. 12, E-17747A

FIG. 12. REPAIR TOOLS FOR LUBE-OIL COOLER.

c. Insert the knock-out rod, shown in Fig. 12, into the tube (behind the guide rod).

d. Gently tap the tube out, taking care not to crush the tube end or to bend it. After the tube has moved about 3/4 in. (19,0 mm), it may be possible to use a rotating motion to pull the tube out of the tube bundle.

e. Inspect the holes in the end plates. They must be free of longitudinal scratches and corrosion. Wire-brush or ream (maximum 0.259-in. or 0.635-in./6,6 or 16,1 mm diameter), if required.

f. Insert a new tube of proper length.

g. Using a tube roller, expand the tube into the end plate at each end of the tube. See Figs. 11 and 12. Insert the roller and expand the tube until it starts to contact the end-plate wall. Measure the tube I.D., then re-roll the tube until the I.D. is 0.002 to 0.004 in. (0,051 to 0,102 mm) larger than the previous measurement. All tubes, holes, and the roller should be clean, to insure a good rolled joint and to prevent damage to the roller.

h. Test the cooler bundle. See Testing the Cooler section. If a replaced tube leaks, re-roll the tube, using an additional interference of 0.002 in. (0,051 mm). If the tube continues to leak with a total interference of 0.008 in. (0,203 mm), replace the tube according to preceding instructions. This type of leak could have been caused by chips, dirt, or a longitudinal scratch in the end plate.

3. If a tube has been damaged to the extent that it cannot be removed for replacement, both ends may be plugged by soft-soldering tapered copper or brass plugs into both ends of the tube. Do not deactivate more than 75 1/4-in. (6,35 mm) tubes, in any one tube bundle, by this method; on small core assemblies, do not deactivate any 5/8-in. (15,88 mm) tubes.

Another method of deactivating a defective tube involves the application of 1/16-in. dryseal pipe plugs in both headers at the leaking-tube location. Drill each header with a 1/4-in. drill to a 1/2-in. depth, thread with a 1/16 in.-27 NPTF tap, apply Loctite* 271 to threads, and install pipe plugs at each location. A 50-cc bottle of Loctite 271 can be purchased as Part 147X1643-1.

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*Product of Loctite Corp.

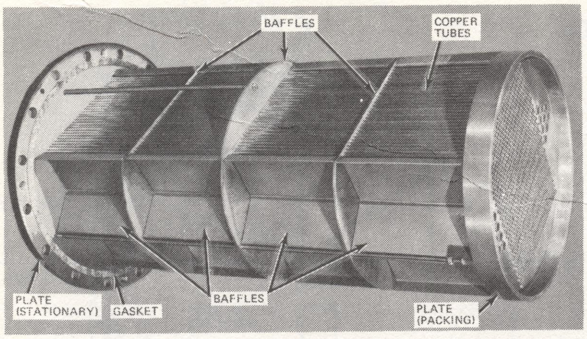


FIG. 13. SMALL TUBE BUNDLE (CORE) ASSEMBLY.

FIG. 13, E-21647

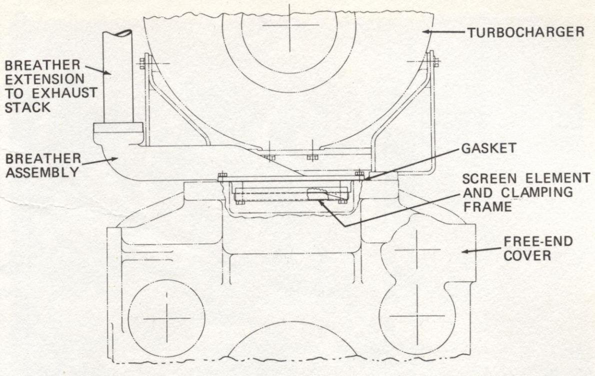

TURBOCHARGER
BREATHER EXTENSION TO EXHAUST STACK
BREATHER ASSEMBLY
GASKET
SCREEN ELEMENT AND CLAMPING FRAME
FREE-END COVER

FIG. 14. CRANKCASE BREATHER.

FIG. 14, E-9990

ASSEMBLY AND TEST

1. After the lube-oil cooler has been cleaned and repaired, assemble the cooler, using new gaskets, packing, and four shims per bolt at the packing flange.

2. Test the cooler at 225 psi (15,82 kg/cm^2 or 1551 kPa) on the shell side. Use a soluble oil-and-water mixture (concentration per vendor's recommendations).

NOTE: *If leakage exists at the packing, it can be observed at one of the four weep holes in the gland ring. See section B-B, Fig. 6.*

3. If the packing leaks, remove one shim at each bolt and retest. If it is necessary to remove more than two shims, disassemble the cooler to determine the cause.

INSTALLATION IN THE LOCOMOTIVE

The cooler is installed by reversing the removal procedure. Assure all pipe connection surfaces are in good condition, and install new gaskets.

After the cooler is in place and all piping is reconnected, close the oil and water drain valves. Fill the water system with properly-treated cooling water and add lube oil to the crankcase as needed. Start the engine, and make a thorough check of the lube-oil and water systems for leaks. After the engine has run for a few minutes, check the lube-oil and water levels and add water or oil, if necessary.

CRANKCASE BREATHER

The crankcase breather, located within the upper portion of the free-end cover, is a closed, shallow, flat cavity cast into the cover (see Fig. 14). The cavity is open to the crankcase and has a case cover at its top, which is sealed with a gasket and bolted in place. A fine-wire-mesh screen panel is mounted within the cover and is held in place by a bolted metal frame (see Fig. 15). The breather is vented into the side of the exhaust stack above the turbocharger by an extension pipe.

Suction developed by the engine exhaust draws the oily vapor from the crankcase, through the breather screen, and out the stack. As the vapor passes through the screen, the oil is caught and drains back to the crankcase.

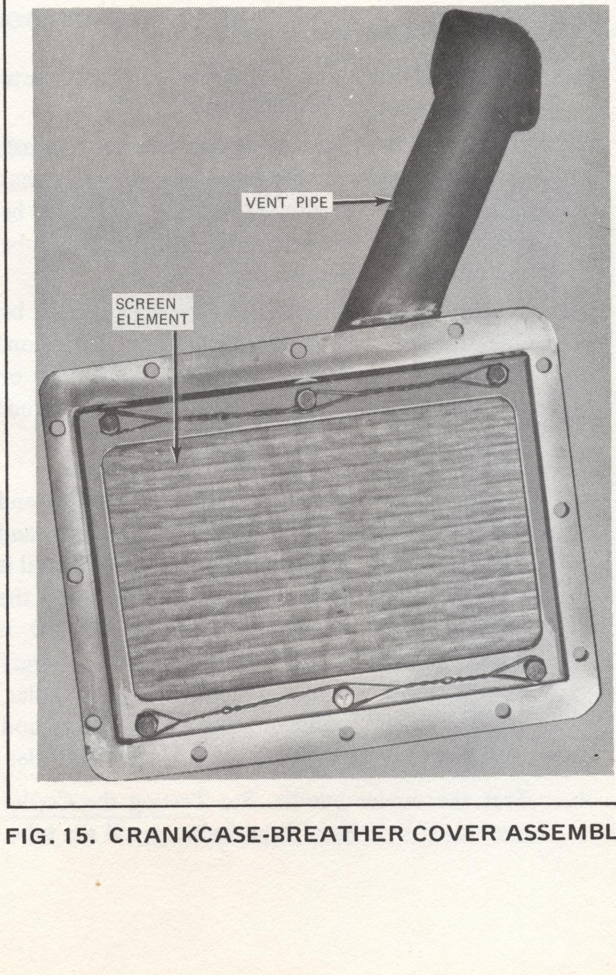


FIG. 15. CRANKCASE-BREATHER COVER ASSEMBLY.

FIG. 15, E-9940

The breather must be kept free of obstructions to function efficiently. It must be disassembled and cleaned during scheduled turbocharger work.

Check for loose bolts and broken lockwires. Ascertain the screen element is not broken, cracked, or otherwise unserviceable. Replace parts as required.

Clean the breather as follows:

1. Remove the breather cover.
2. Disassemble and thoroughly clean the screen, cover parts, extension pipe, and breather cavity, using a suitable solvent.
3. Assemble the cover, apply a new gasket, and install.

LUBE-OIL PUMP

The lube-oil pump (Fig. 16) is of the positive-displacement gear type. Its tapered shaft is fitted with a keyed drive gear which is driven by the engine idler gear. The pump is rabbet-fit to the free-end cover to provide interchangeability and self-alignment. The pump is held in place by a bolted flange, which is sealed by a gasket.

Two gears, contained in the pump, rotate on bronze bushings and are lubricated by the oil being pumped.

REMOVAL

1. Drain the oil from the engine crankcase, the free-end cover, and the filter. (See Draining the System, Steps 1 and 5.)
2. Disconnect the discharge pipe at the pump.
3. Install a 3/4-10 lifting eyebolt into the pump frame and attach a crane hook to support the pump weight.
4. Remove the pump flange bolts. Install 5/8-11 jack bolts in the holes provided, and turn the bolts evenly until the pump can be removed.

DISASSEMBLY (See Fig. 17)

1. Remove the drive-gear lock nut, drive gear, and key from the drive shaft. Three holes are provided in the gear hub to facilitate the use of a gear puller.
2. Remove the hex-head nuts from the pump face plate. Install 1/2-13 jack bolts into the holes provided, and jack evenly until the plate is removed.
3. Remove the outer bushings. Note the numbers stamped on each bearing and case to provide correct bearing location during reassembly.
4. Remove the drive gear and shaft and the idler gear and shaft.

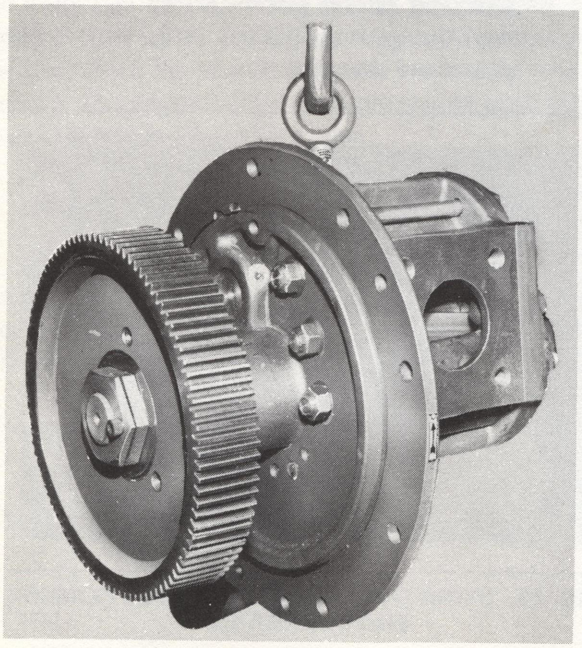
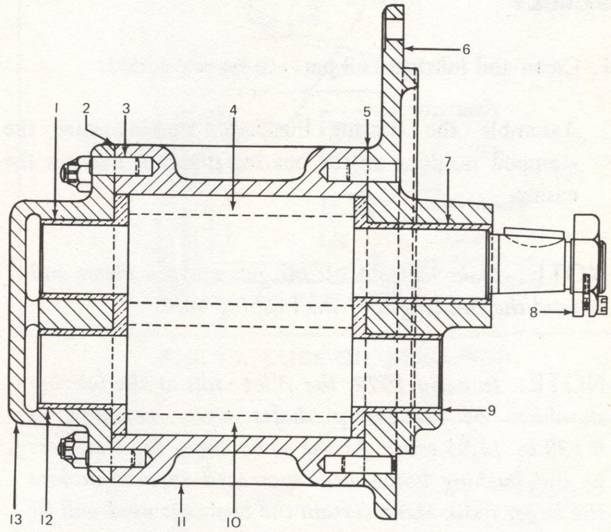


FIG. 16. LUBRICATING-OIL PUMP (END VIEW).



REF.	DESCRIPTION	REF.	DESCRIPTION
1	BUSHING (PART STAMPED NO. 10F)	8	LOCK NUT
		9	BUSHING (STAMPED NO. 10)
2	FACEPLATE GASKET	10	IDLER GEAR AND SHAFT
3	DOWEL PIN	11	CASING
4	DRIVE GEAR AND SHAFT	12	BUSHING (STAMPED NO. 9)
5	BACKPLATE GASKET	13	FACEPLATE
6	BACKPLATE		
7	BUSHING (STAMPED NO. 21B)		

FIG. 17. CROSS-SECTION VIEW OF LUBE-OIL PUMP.

FIG. 17, E-10002B FIG. 16, E-9927

5. To remove the casing from the backplate, unscrew the hex nuts on the backplate and pull the plate from the casing. Remove the backplate bearing bushings.

MAINTENANCE

Carefully examine the surface of the gears. Slight burrs or feather edges may be removed with a hand stone. With a file, remove all burrs and foreign matter on mating surfaces, such as both faces of the bronze bearing bushings and the gasketed surfaces of the endplates and casing.

Examine the bearings for excessive wear. Condemn the pump if the gears rub the case bore. Examine the gears carefully for signs of wear or bending of the shaft ends.

Correct dimensions and tolerances for new and worn pumps are given in the DATA section, and these should be used to determine the pump condition. Pumps should be within specified tolerances before being put in service.

Should studs become loose, they should be reassembled to the faceplate or backplate in the following manner:

1. Thoroughly clean both the stud thread and tapped hole. Remove all trace of oil by cleaning with Locquic Primer, Grade N or T.
2. Apply Loctite 271 to threaded surfaces and assembly. No special torque is required.

ASSEMBLY

1. Clean and lubricate all parts to be assembled.
2. Assemble the bearing bushings, making sure the stamped number on the bearing matches that on the casing.

NOTE: *Make certain all oil grooves are clean and extend the full length of the bushing bore.*

NOTE: *In early 1972, the fillet radii at the bearing shoulders of the pump shafts were increased to 0.120 in. (3,05 mm). At the same time, the chamfers in the bushing bores were increased to accomodate the larger radii. Make certain the bushings used will fit completely to the gear faces, without binding on the radii.*

3. Secure the backplate to the casing.
4. Insert the gear shafts in their proper locations.
5. Assemble the bearing bushings in their corresponding locations in the faceplate.
6. Secure the faceplate to the casing, and tighten the hex nuts in increments in a criss-cross manner to 70 lb.-ft. (95 N·m) of torque. Lubricate all threads with Lubriplate* Spray Lube "A", GE Part 147X1614.
7. Rotate the shaft by hand to ensure gears and bearings are not binding.
8. Check axial end clearance and correct if outside the limits given in the DATA section. Use the following procedure:
   a. Set up a dial indicator as shown in Fig. 18. Attach the magnetic base of the indicator to the pump backplate; position the indicator probe on the face of the drive gear or on the face of the gear lock nut, which can be temporarily assembled.
   b. Move the drive gear to its two extreme axial positions and note the indicator movement (end clearance).
   c. If end clearance is not within the limits given in the DATA section, adjust the thickness of the gasket between the faceplate and casing. New pumps usually have two Part 139X1102 gaskets, each 0.005 in. (0,127 mm) thick, at this location. Use either standard 0.005 in. (0,127 mm) thick gaskets or thicker gaskets, shown in Table I, to vary the gasket thickness and, thus, achieve correct end clearance.

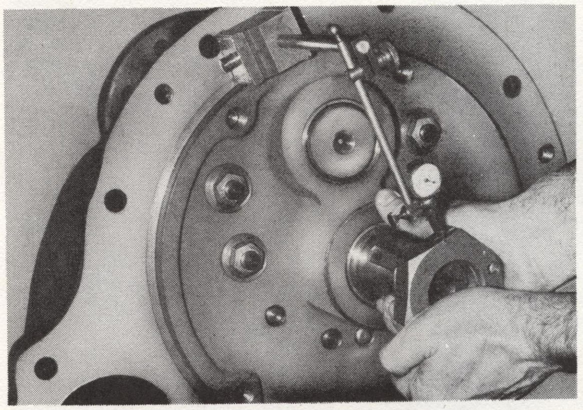


FIG. 18. USING DIAL INDICATOR TO DETERMINE END CLEARANCE.

FIG. 18, E-21503

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*Product of Fiske Bros. Refining Co.

9. Install the drive gear and key on the drive shaft and secure with the lock nut tightened to 375-400 lb.-ft. (508-542 N·m) of torque.

TABLE I, FACEPLATE GASKETS

PART NO.	MANUFACTURED THICKNESS		APPROXIMATE COMPRESSED THICKNESS	
	in.	mm	in.	mm
139X1102	0.005	0,127	0.004	0,102
139X1238	0.010	0,254	0.008	0,203
139X1239	0.015	0,381	0.012	0,305
139X1240	0.021	0,533	0.016	0,406

INSTALLATION

1. Clean the gasket surfaces, and use new gaskets where needed.

2. Insert a 3/4-10 lifting eyebolt into the oil-pump housing (see Fig. 16). Position the pump on the engine with an overhead crane.

3. Hand-tighten the pump and discharge pipe bolts to ensure the compression pipe coupling is aligned.

4. When the pipes are aligned, tighten the mounting bolts to 90 lb.-ft. (122 N·m) of torque if bolts are dry; to 70 lb.-ft. (95 N·m) of torque if bolts are lubricated.

Close the oil drain valves and fill the crankcase to the proper level before starting the engine. After starting the engine, check the lube-oil pump for overheating or unusual noises. The engine lube-oil pressure should agree with the values shown in the DATA section.

CRANKCASE LUBE-OIL STRAINER

The lubricating oil system is provided with a lube-oil strainer. It is located in the oil pan and is accessible thru crankcase inspection openings at each side of the engine. Details of the strainer are shown in Fig. 19.

The strainer basket should be removed and cleaned:

1. Whenever the lube-oil supply is drained

2. After any major damage has occurred inside the crankcase.

To remove the basket:

1. Lower the level of the lube oil in the crankcase to fully expose the strainer cover.

2. Remove strainer cover by working through the crankcase inspection openings. THIS COVER IS IDENTICAL TO THOSE USED TO COVER THE CRANKCASE INSPECTION OPENINGS.

3. Lift out basket.

To clean the basket:

1. Remove basket from engine.

2. Flush the basket with suitable solvent.

3. Blow basket clean using compressed air. Direct air from the outside of the basket toward the inside.

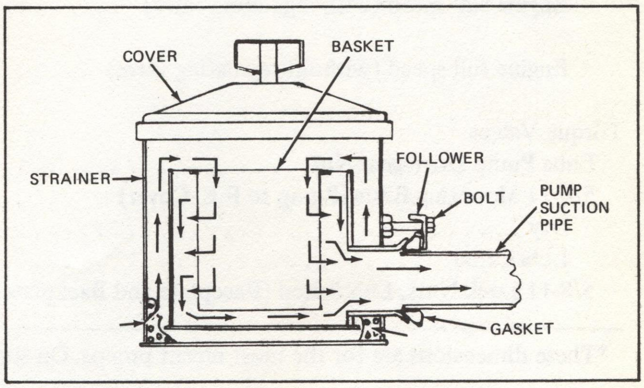

FIG. 19. LUBE-OIL STRAINER.

FIG. 19, E-16662

DATA

	English	Metric
System Oil Capacity		
– 8-Cylinder Engine	260 U.S. gal.	984 liters
– 12-Cylinder Engine	276 U.S. gal.	1045 liters
Pump		
Speed Ratio	1.104 to 1	
Drive-shaft Bearing		
Running clearance on diameter (new)	0.0055-0.007 in.	0,140-0,178 mm

DATA (Cont'd.)

	English	Metric
Maximum worn	0.012 in.	0,305 mm
Drive-shaft outside diameter (new)	2.3060-2.3065 in.	58,572-58,585 mm
Idler-shaft Bearing		
Running clearance on diameter (new)	0.0055-0.0070 in.	0,140-0,178 mm
Maximum worn	0.012 in.	0,305 mm
Idler-shaft outside diameter	2.3060-2.3065 in.	58,572-58,585 mm
Pump Gear-to-Gear Radial Clearance (new)	0.00175-0.00705 in.	0,044-0,179 mm
*Gear outside diameter	4.361-4.360 in.	110,769-110,744 mm
Pump Gear Axial Clearance (new or rebuilt)	0.010-0.020 in.	0,254-0,508 mm
Gear length (new)	7.498-7.501 in.	190,449-190,525 mm
*Maximum allowable diametral clearance between case bore and gear O.D.	0.020 in.	0,508 mm
*Minimum allowable diametral clearance between case bore and gear O.D.	0.017 in.	0,432 mm
Engine Stopped Oil Pressure Switch (LPS)		
Pick-up	12 psi	0,84 kg/cm^2 or 83 kPa
Drop-out	6 psi	0,42 kg/cm^2 or 41 kPa
Pressure-Relief Valve (Set with Lube Oil Cold)	135-140 psi	9,49-9,84 kg/cm^2 or 931-965 kPa
Pressure Regulating Valve (If Used) (Set at Max. Speed, Oil Hot)	75 psi	5,27 kg/cm^2 or 517 kPa
Engine Header Pressure (Normal Operating Temperature)		
At Test Point in Governor Supply Line		
Engine idle (approximately)	20 psi	1,41 kg/cm^2 or 138 kPa
Engine full speed (with regulating valve)	65-75 psi	4,57-5,27 kg/cm^2 or 448-517 kPa
Engine full speed (without regulating valve)	85-100 psi	5,98-7,03 kg/cm^2 or 586-689 kPa
Torque Values		
Lube Pump Drive-gear Nut	375-400 lb.-ft.	508-542 N·m
5/8-11 Mounting Bolts (Pump to F.E. Cover)		
Dry	90 lb.-ft.	122 N·m
Lubricated	70 lb.-ft.	95 N·m
5/8-11 Lock Nuts, Lubricated (Faceplate and Backplate to Casing)	70 lb.-ft.	95 N·m

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*These dimensions are for the most recent pumps. On some previous models, the dimensions are as follows:

	English	Metric
Gear outside diameter	4.351-4.352 in.	110,515-110,541 mm
Maximum allowable diametral clearance between case bore and gear O.D.	0.029 in.	0,737 mm
Minimun allowable diametral clearance between case bore and gear O.D.	0.026 in.	0,660 mm

TRANSPORTATION SYSTEMS BUSINESS DIVISION, GENERAL ELECTRIC COMPANY, ERIE, PA. 16531

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